

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SEVENTH SERIES.]

No. 102. JUNE 1906.

LXVIII. — *Some new and little-known Trematodes.* By
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[Plates XII. & XIII.]

THE endoparasitic Trematode fauna of this country is a subject which has of late received but scant attention from zoologists. Since Cobbold's time practically no systematic work of note has been done. Jameson's attempt* to solve the much-disputed question of pearl-formation in mussels and other Lamellibranchs is possibly the most important work on the group.

This contrasts unfavourably with affairs in other countries, where helminthology in general, and particularly that branch of it relating to Trematoda, has within recent years been receiving very considerable attention. Von Linstow, Braun, Brandes, Lühe, and Mühling in Germany, Stossich and Monticelli in Italy, and Looss in Egypt have devoted the greater part of their time and energy to this department of zoology. Zschokke and Hausmann in Switzerland and Jägerskiöld and Odhner in Scandinavia have helped much to increase our knowledge of the bird and fish Trematode parasites of these countries, while in America many workers are engaged in the study of the freshwater-fish parasitic fauna.

While it is true that, owing to the migratory habits of

* Proc. Zool. Soc. 1902, i. p. 140.

birds and fishes, the Entozoan parasites of each species tend to be alike in every country, there is no doubt that by reason of unique local circumstances the parasites of a particular host, or in some cases a particular parasite itself, are more easy of study in one country than in another. The same, of course, applies to different localities in the same country. The presence of a rich invertebrate fauna, harbouring sporocysts and cercariæ, and at the same time easy of access, is beyond question a most important aid in the study of the adult parasites occurring in the vertebrate hosts. Besides ensuring that in these hosts infection will be frequent, it affords the means of studying the parasites throughout the various stages of their development. Many places in this country, and amongst them St. Andrews (where, owing to the labours of Professor M'Intosh, the marine invertebrate fauna is comparatively thoroughly known*), satisfy these conditions, so that it is surprising that more labour has not been expended on this subject. From the following notes, which are in many cases the result of casual observation, it will be evident that much research might, with a considerable prospect of success, be devoted to the elucidation of the British Trematode fauna.

The hosts which I have had an opportunity of examining are only such as occur with considerable frequency and are commonly brought down by "caddies" or others out for a day's shooting. The few fish noticed are some which have died while in confinement in the tanks at the Laboratory. I hope to be able to undertake a more extended study during the ensuing months.

The hosts with their respective parasites are as follows:—

Larus ridibundus.

Echinostomum secundum, sp. n.

Larus argentatus.

Zeugorthis acanthus, gen. et sp. n.

Echinostomum secundum.

Levinsenia similis, *Jägerskiöld.*

Tocotrema lingua, *Creplin.*

Hematopus ostralegus.

Echinostomum secundum.

Levinsenia similis.

Di-tomum brevicolle, *Creplin.*

— minutum, *Cobbold.*

Monostomum ignotum, sp. inq.

* Cf. e. g. 'Marine Invertebrate Fauna and Fishes of St. Andrews,' together with many papers of note.

Harelda glacialis.

Monostomum attenuatum, Rud.

Colymbus septentrionalis.

Distomum sp.

Gasterosteus aculeatus.

Psilostomum reductum, sp. n.

The following contained no Trematode parasites:—

Larus marinus (one specimen).

Totanus calidris "

Corvus cornix "

Uria troile "

Edemia nigra (two specimens).

Phasianus colchicus (two specimens).

Blennius pholis (one specimen).

Echinostomum secundum, sp. n. (Pl. XII. figs. 1-3.)

In the intestine of a black-headed gull (*Larus ridibundus*) three specimens were found. The smallest was 5.4 mm. long, the largest 7.3 mm. The body is long and narrow, flattened dorso-ventrally. The breadth varies considerably in different parts of the body. Across the head in the largest specimen it is .33 mm., at the neck (constriction just behind head) .27 mm., at the ventral sucker .52 mm., and at the widest part of the body (on a level with the anterior testis) .70 mm., from which it tapers gradually to the extremity.

The oral sucker is terminal, but set at an angle of 45° with the longitudinal axis of the body. Its diameter is .11 mm. The ventral sucker, situated at a distance of .7 mm. from the anterior end, measures .33 mm. in diameter. Both suckers are globular and have a circular aperture.

The cuticle is thrown into transverse folds, which give the surface a rugose appearance. These folds increase in size from the anterior end; posteriorly they broaden out and become indistinct. The summit of each fold is studded with numerous little spines, which also increase in size in passing backwards. They are almost entirely absent from the posterior third of the body. Around the oral sucker appears the well-defined row of cephalic spines (Pl. XII. figs. 2, 3, *Sp.*) distinctive of the genus. The spines are twenty-nine in number and are set on a sort of ridge, which encircles the anterior end except in the mid-ventral line, and forms the "head." With the exception of two at each end they are arranged in a single uninterrupted row. The exceptions are

on a different level from the rest and are smaller in size. They measure $\cdot 026$ mm., while the others have a length of $\cdot 050$ – $\cdot 053$ mm.

The mouth opens in the oral sucker and is followed by a narrow œsophagus $\cdot 50$ mm. long. At a distance of $\cdot 03$ mm. from the oral sucker there is a small muscular œsophageal bulb (pharynx) measuring $\cdot 10 \times \cdot 05$ mm. The œsophagus divides into two intestinal diverticula just in front of the ventral sucker. The diverticula extend the whole length of the body.

The testes, a pair of egg-shaped bodies, are situated in the posterior third of the body, one behind the other, the posterior being at a distance of $\cdot 94$ mm. from the hinder end. They measure $\cdot 66 \times \cdot 40$ mm. and $\cdot 80 \times \cdot 42$ mm. respectively. Further forward is the ovary, measuring $\cdot 27 \times \cdot 20$ mm., the long axis being transverse. The shell-gland lies behind the ovary, two folds of the uterus intervening. The uterus is much convoluted and the ova are numerous. The latter vary in size and colour. Those nearest the ovary are largest. They are colourless and measure $\cdot 093 \times \cdot 062$ mm. Further forward they assume a yellowish tint and their size is $\cdot 087 \times \cdot 056$ mm. The most anterior ova are brown in colour and measure only $\cdot 082 \times \cdot 053$ mm.

The genital aperture is closely apposed to the anterior border of the ventral sucker and lies slightly to the left of the middle line. It is elliptical in outline. The vitelline glands are lateral in position and extend from a distance of $\cdot 52$ mm. behind the ventral sucker to the posterior extremity of the body. They are dark in colour.

The excretory system consists of a pair of narrow tubes, one on each side, running the whole length of the body. These give off numerous branches. At the posterior end there is a large, distinct, excretory aperture, having the appearance of being surrounded by a series of longitudinal muscular fibres.

A species of *Echinostomum* (*E. spinulosum*) has already been observed in *Larus ridibundus*. This is noted by Diesing* and Bellingham†. *Echinostomum spinulosum* is one of the commonest species of the genus and occurs in *Colymbus septentrionalis*, *Podiceps cristatus*, *Carbo graculus*, *Numenius arquatus*, *Larus argentatus*, *capistratus*, *glaucus*, and some others. It has been described and figured by

* Syst. Helm. i. p. 392.

† Ann. & Mag. Nat. Hist. 1844, xiii. p. 426.

Dujardin *, Diesing, Molin †, Von Linstow ‡, Cobbold § and Müller ¶, so that its specific characters are well known. The features which distinguish it from *E. secundum* are: (1) the shape of the head, (2) the number of cephalic spines being only twenty-two, (3) the forward position of the testes, (4) the curtailed extent of the vitelline glands, (5) the relative sizes of the suckers. That these features are of diagnostic importance in the determination of species is recognized by most observers. According to Müller ¶, "several forms appear to be described under *E. spinulosum*, which, on more exact knowledge of the number of cephalic spines, extent of vitelline glands, and size of ova, will be distinguished from each other." Looss ** discusses the affinities of several species of *Echinostomum*, each possessing twenty-two cephalic spines. They differ from each other in very slight detail, such as the size of the suckers and œsophageal bulb, the size and arrangement of the cephalic spines, and the sizes and positions of the ova, testes, and vitelline glands. It is possible, therefore, that *E. secundum* may have been already observed and, on cursory examination, mistaken for *E. spinulosum*.

In the number and arrangement of the cephalic spines *Echinostomum secundum* probably stands nearest *E. leptosomum*, Creplin, described by Villot †† from *Tringa variabilis (alpina)* and *Calidris arenaria*. This species possesses 28–30 cephalic spines of length .04 mm. Two spines at each end are on a different level from the others, but according to Villot they do not differ from them in size. The head is not marked off from the rest of the body by a constriction. The suckers also differ in size, while the ventral sucker is distinguished by the possession of a crenated margin. The œsophageal bulb, testes, and ova are all much smaller, although the animal itself is nearly half as long again as *E. secundum*.

Villot describes as the larval form of *E. leptosomum*, *Cercaria leptosoma*, occurring in cysts in the foot of *Scrobicularia tenuis*. There is much reason to believe that the corresponding larval form of *E. secundum* is identical with that

* Hist. d. Helm. p. 430.

† Wien. Denkschr. xix. p. 220.

‡ Arch. f. Naturg. 1877, p. 183.

§ Trans. Linn. Soc. xxii.

¶ Arch. f. Naturg. lxiii. p. 20 (1897).

¶¶ *Loc. cit.*

** Zool. Jahrbücher, 1899, xii. p. 689.

†† Ann. d. Sc. nat. 1879, viii. p. 24.

which I have already described* from *Cardium edule*, *Mytilus edulis*, and *Macra stultorum*. I have not been able to prove this as Villot did, in the case of *Cercaria leptosoma*, by observing the development of the cercaria into the adult within the intestine of the host; but comparison of the adult with the encysted cercariæ in the cockle brings out several points of resemblance. The most marked is the close agreement in the number and disposition of the cephalic spines. In both the number is 29, and they are arranged round the oral sucker in a single row, uninterrupted, save in the mid-ventral line. The peculiar arrangement of the spines at each end, where two are on a different level from the rest and much smaller in size, is the same in both. The shape and position of the suckers also correspond, allowance being made for the great backward elongation of the body in the adult. The initial stages of this transformation I have observed within the intestine of *Hæmatopus ostralegus*, in which several cercariæ which had only recently emerged from the cyst were found. They differed from the encysted cercariæ in the cockle in no respect save the increased length of the body. Comparison of the measurements of these with corresponding measurements in the encysted cercaria and in the adult found in *Larus ridibundus* demonstrates the fact that the growth of the suckers compared with that of the length of the body takes place in the same proportion from the first to the second stage as from the second to the third. This will be best seen from the following table:—

	Encysted cercaria in cockle.	From <i>Hæmatopus</i> .	From <i>L.</i> <i>ridibundus</i> .
Length	·77 mm.	1·21 mm.	7·29 mm.
Oral sucker (diameter)	·065 "	·068 "	·11 "
Ventral sucker "	·095 "	·112 "	·33 "
Increase in length .....	..	·44 "	6·08 "
" oral sucker .....	..	·003 "	·042 "
" ventral sucker ....	..	·017 "	·218 "
Ratio of increase in oral sucker to increase in length ....	..	1 : 147	1 : 145
Ditto, ventral sucker .....	..	1 : 26	1 : 23

From these considerations it seems probable that *Echino-stomum secundum* is the adult form of the encysted cercariæ of the cockle and the mussel †.

* Ann. & Mag. Nat. Hist. ser. 7, xvii. p. 148, pl. iv. fig. 5.

† Later I found *E. secundum* occurring very numerously in *Larus argentatus*. The examples in this case were in an earlier stage of development, being smaller than those in *L. ridibundus* and containing few or

Zeugorchis acanthus, gen. et sp. n.
(Pl. XII. figs. 4, 5; Pl. XIII. figs. 6, 7.)

From the bursa fabricii and cloaca of the herring-gull (*Larus argentatus*).

The body is of a somewhat oval outline; flattened ventrally, convex dorsally. It is divided into three portions. The anterior, corresponding to the head, bears the oral sucker, surrounded by a collar carrying a row of spines. It is separated from the rest of the body by a distinct though not deep constriction. The breadth at the collar is .87 mm. The middle portion of the body is flattened and expanded, with a breadth of 1.60 mm. In the posterior portion the breadth reaches a maximum of 2.11 mm., from which point it diminishes rapidly to the end. The posterior end is blunt. The length of the whole animal is 3.91 mm., of which the posterior part comprises 2.43 mm., or nearly two thirds.

The cuticle is beset with numerous rows of stout spines (Pl. XII. fig. 5). These cover the whole of the middle portion of the body and part of the posterior. They are almost entirely absent from the posterior half. The spines vary considerably in size, those in front measuring .019 mm., while those further back attain a length of .031 mm. The rows are about .025 mm. apart anteriorly, but become more widely separated on passing backwards.

The ridge bearing the cephalic spines is somewhat peculiar. It bears a distinct resemblance to the collar of a coat, and differs greatly from the corresponding structure found in the genus *Echinostomum*. It is flat, with very definite outline, and its edges are carried right up to the oral sucker, so that the terminal spines are contiguous with the rim of the sucker. About 12 spines can be seen on each side in a ventral view, while dorsally there are about 30, the total number being about 60. They are all nearly equal in size (about .037 mm.), but ventrally they appear to diminish somewhat as they approach the end of the ridge, so that the spines nearest the sucker are the smallest. The surface of the collar is slightly furrowed by muscular bands running down to meet the spines.

no ova. Ovary comparatively small and vitelline glands scanty. Cephalic spines 29 in number, reaching a length of .065 mm. in some cases. The herring-gull from which the specimens were obtained was much infected with parasites, *Tocotrema lingua* and *Levinseniia similis* occurring in great numbers. Each parasite was confined to a particular part of the gut, the order being *Echinostomum*, *Tocotrema*, *Levinseniia*.

The suckers are large and muscular. Both are globular. The oral sucker has a diameter of .50 mm., with a circular aperture of .26 mm. The ventral sucker is situated at the level of the junction of the middle and posterior parts of the body. Its diameter is 1.08 mm. The mouth opens in the oral sucker and is continuous with a large pharynx, there being no pre-pharynx. The pharynx is .24 mm. long. From this the intestine almost immediately divides into two wide branches, which pass down the whole length of the body nearly to the posterior end.

The genital organs are not distinct, being obscured by the numerous ova which occupy the greater part of the posterior portion of the body. Not far from the ends of the intestinal diverticula and contiguous with them are two large somewhat circular testes, about .55 mm. in diameter, placed closely together side by side. The ovary is slightly in front, but hidden by the ova. The vitelline glands are of small extent, being confined to the posterior part of the body, behind the ventral sucker. They are in two rows, one on each side of the body, at some distance from the margin. The genital aperture is situated on a small prominence just in front of the ventral sucker. The aperture is elliptical and very distinct. There is apparently no penis-sac.

The ova are numerous and rather peculiar. They are of two kinds: the younger are in the rear and vary in length from .081 to .095 mm., the breadth being .040 to .044 mm.; the older ova (Pl. XIII. fig. 7) are larger, measuring .106 to .113 mm. \times .056 to .062 mm.; they are distinguished from the younger by being lighter in colour and by the presence of a dense, dark, variably shaped spot about .014 to .016 mm. in diameter. In many cases this has the form of a cross. It is not difficult to perceive in this the "eye-spots" of the *Miracidium* larva developing within the egg-capsule. In this species the "eye-spots" are particularly large and distinct, so that they form the most striking feature of the ova at first sight.

In one specimen several ova were observed lying in the cavity of the ventral sucker. From many of these the capsule had been ruptured, the rupture having taken place in the direction of the long axis, so that two equal halves remained, united at one extremity. From this it is probable that the ovum develops completely into the *Miracidium* within the uterus, and there is a suggestion that the ventral sucker acts as a sort of receptacle for the ova until the capsule is ruptured and the *Miracidia* are set free. In the absence of fuller information this can only remain a supposition, and

the occurrence is more likely to be the result of chance. There is no doubt, however, that the *Miracidia* are set free before the ova leave the host, as occurs in some other forms, e. g. *Distomum macrostomum* and *D. lanceolatum* *.

The systematic position of this species is difficult to decide. It certainly cannot be classed in the genus *Echinostomum*, for, although it has a circum-oral collar, bearing spines, the shape of the collar and the arrangement of the spines on it are quite unlike any found in that genus. Moreover, it differs widely in internal structure. The most important features of difference are: (1) the apposition of the pharynx to the oral sucker and the absence of œsophagus, (2) the position of the testes, (3) the situation and extent of the vitelline glands, (4) the advanced development of the ova. These features are of generic importance. For the same reasons it cannot be included with any of the allied genera *Stephanostomum*, *Acanthostomum*, *Centrocestus*, and *Ascocotyle*, each of which possesses a crown of spines round the mouth. In its internal anatomy it approximates more closely to the genus *Pygorchis*, Looss †, but in spite of certain similarities the points in which it differs are of sufficient importance to prevent its inclusion in that genus. It bears the closest resemblance of all to an as yet unique species, *Distomum pittacium*, Braun ‡. Together they agree with *Pygorchis* in having the intestinal diverticula extending almost to the posterior extremity of the body, the vitelline glands of small extent and entirely behind the ventral sucker, and in the presence of well-developed eye-spots within the ova. *Pygorchis*, however, differs in having the testes placed obliquely behind each other, in having the vitelline glands stretching obliquely across the body, in the forward position of the genital aperture, and in the possession of a penis-sac. In addition, *Pygorchis* is destitute of spines of any description. *Distomum pittacium* also entirely lacks spines, and in Braun's figure there is not the slightest vestige of a collar round the oral sucker. The otherwise remarkable resemblance between this species and *Zeugorchis acanthus* inclines one to doubt whether Braun's species was really provided with spines or not. Judging from the tenacious manner in which the spines remain fixed to the body in my examples, it seems very unlikely that they can have been completely stripped off; besides, in any case, the collar would remain.

The question now is whether *Distomum pittacium* is to be

* Bronn's 'Thierreich,' Vermes, I. i. p. 778.

† Zool. Jahrbücher, Syst. xii. p. 587.

‡ *Op. cit.* xvi. p. 146.

included along with *Zeugorchis acanthus* in the same genus or not. This will be done with more or less readiness according to the importance attached to the presence of the collar and spines. As regards internal anatomy the two are well-nigh identical.

In choosing a generic name I have studiously avoided reference to the spines or the circum-oral collar, so that in the event of the inclusion of *Distomum pittacium* the name may not be inappropriate. The close apposition of the testes seemed to me a sufficiently diagnostic point on which to found the generic name.

Levinsenia similis (*Spelotrema simile*), Jägerskiöld.
(Pl. XIII. fig. 8.)

From the intestine and cæca of a herring-gull (*Larus argentatus*) considerably over a hundred examples of this parasite were obtained. While they correspond closely in their structure to Jägerskiöld's exhaustive description* of the species (as *Levinsenia pygmæa*, var. *similis*), yet they differ slightly in one or two particulars and very much in size.

Levinsenia pygmæa was first described as *Distomum pygmæum* by Levinsen † from *Somateria mollissima*. According to him it was of very small size, its length rarely exceeding .5 mm., usually much smaller. The oral sucker, too, was always slightly larger than the ventral. Jägerskiöld later found a similar form occurring in *Larus argentatus* and *L. fuscus*. The size, however, was considerably greater and the oral sucker was smaller than the ventral. The most striking peculiarity of the species is the arrangement of the genital system. The situation of the testes and ovary is not unusual, but the occurrence of a large vesicula seminalis just in front of the ventral sucker and the position of the genital aperture to the left of the same sucker, together with the presence of a genital sinus, are diagnostic features.

Jägerskiöld compares the specimens which he found in *Larus* with those found both by Levinsen and himself in *Somateria mollissima*. The size of the former, as already mentioned, exceeds that of the latter considerably. The length of my specimens from *Larus*, however, shows a much greater divergence. Out of about 30 examples measured, none possessed a length of less than .85 mm., and many of them greatly exceeded this, attaining in some cases a length of 1.30 mm. The breadth of the body and the sizes of the

* Centralbl. f. Bakt. &c. xxvii. p. 732.

† Bidrag til Kundskab om Grönl. Trematodfauna, p. 23, pl. iii. fig. 2.

various structures are proportionately large. Comparison with Jägerskiöld's specimens will best be seen by the following list of measurements:—

	Jägerskiöld.	
	mm.	mm.
Length	·42 -·60	·85 -1·30
Maximum breadth.....	·20 -·22	·35 - ·44
Oral sucker (diameter)	·048-·060	·07 - ·08
Ventral sucker (diameter)	·052-·064	·07 - ·095
Pharynx (length)	·032-·036	·043- ·049
" (breadth)	·020-·022	·030- ·037
Undivided intestine	·16 -·20	·37 - ·61
Intestinal diverticula.....	·1 -·13	·23 - ·37
Ovary	·050	·09 - ·11
Testes		·13 × ·09
Ova	·023 × ·011	} ·022- ·025 × ·009- ·011

From this it is evident that the only point of correspondence is in the size of the ova. In this connexion some of my specimens show a number of ova towards the end of the uterus, which are much larger than the others, measuring $\cdot 028 \times \cdot 019$ mm. A feature which Jägerskiöld does not mention is that the uterus starting on the right side contains almost colourless ova on that side, while on the left the ova have a brownish-yellow colour and are very slightly larger.

As regards the general contour, Levinsen figures *Distomum pygmaeum* somewhat after the fashion of an isosceles triangle. Jägerskiöld, however, never found specimens of that shape either in *Larus* or in *Somateria*. To his mind the form is biscuit-shaped ("biscuit-förmig") and sometimes, but rarely, club-shaped ("keulen-förmig"). He depicts* a young specimen from *Hæmatopus ostralegus* which shows this latter shape. He adds that in life the animal is probably pear-shaped, with a greater or less concavity on the ventral side of the anterior part of the body. Now the majority of the examples which have come under my observation have, or tend to have, this pear-shaped or club-shaped form, although at the same time they are considerably flattened dorso-ventrally; many of them are, certainly, not so attenuated anteriorly, but there is always a marked distinction, often, indeed, a constriction between anterior and posterior parts, and the latter is always well rounded.

Jägerskiöld makes no mention of having found *Levinsenia similis* in the intestinal cæca of *Larus argentatus*. I found

* *Op. cit.* p. 734.

specimens occurring there in considerable numbers and of much larger size than those in the intestine. One exceptionally large specimen reached a length of 1.56 mm. and the others all exceeded 1 mm. It was noticeable that, in passing down the intestine, the specimens tended to increase in size.

The advisability of making a new species for the *Levinsenia* from the gulls has been discussed by Jägerskiöld. While inclined at first to regard it merely as a variety of *L. pygmaea*, he later* raised it to the position of a distinct species. Further he makes it the type of a new genus, *Spelotrema*, including *Distomum pygmæum*, *macrophallos*, and *claviforme*, distinct from the genus *Levinsenia*, of which *D. brachysomum* was the type. Looss†, however, does not entirely agree with this, maintaining that as *D. brachysomum* was a species inquirenda it could not be employed as a genus type, and that therefore the name *Levinsenia* ought rightly to remain for the species included under Jägerskiöld's *Spelotrema*, with *L. similis* as the type.

That my specimens are identical with those of Jägerskiöld there can be little doubt, despite the disparity in size. The relative size of the suckers, which enabled Jägerskiöld to differentiate *L. similis* from *L. pygmaea*, is usually a point of diagnostic importance. In this respect my experience agrees with that of Jägerskiöld; although it is certainly a matter of some difficulty to decide in this case, for in many examples the ventral sucker, by reason of compression, acquires an elliptical form, the long axis being as often longitudinal as transverse. In a large series of measurements it was found that the ventral sucker was in most cases, if not all, slightly larger than the oral. The inclusion of *Distomum claviforme*, Brandes‡, within the genus *Levinsenia* is open to question. As Jägerskiöld says, it is a species impossible to identify. Brandes's figure certainly leaves much to be desired and his description is by no means full. Jägerskiöld's interpretation § of Brandes's figure is plausible and seems necessary if *D. claviforme* is to take its place alongside the other species in the genus *Levinsenia*. On this assumption it would bear a very strong resemblance to my specimens of *L. similis* both in shape and structure, for it has the typical club shape, although of much smaller size (.3-4 mm.).

Brandes sees in *Distomum claviforme* the adult of the

* Centralbl. Bakt. xxx. p. 982 (1901).

† Zool. Jahrbücher, xvi. p. 705.

‡ Arch. f. Naturg. liv. p. 247.

§ Centralbl. Bakt. xxvii. p. 739.

encysted cercaria described by Professor McIntosh* from *Carcinus mænas* and *Cancer pagurus*. He bases his assumption on the close resemblance between the cercaria and the adult, and endeavours to correlate the various structures in them. He is possibly correct, but there is just as much ground for assuming that *Levinsenia* from *Larus* is the adult of the cercaria from *Carcinus*. The shape and the structure show just as much resemblance. The occurrence of the adult in such great numbers corresponds, too, with the exceptional frequency and abundance of the cysts in the crab. Until proper feeding experiments have been conducted or more accurate information is forthcoming the point must remain in abeyance, though it is known that gulls and other birds readily devour *Carcinus* and *Cancer*, *e. g.* after storms on the West Sands at St. Andrews.

Psilostomum redactum, sp. n. (Pl. XIII. fig. 9.)

From the intestine of the 3-spined stickleback (*Gasterosteus aculeatus*).

The stickleback has been examined by several observers, yet, although quite a number of parasites are described from it, only two Distomidæ, viz. *Distomum ventricosum* and *D. appendiculatum*, have so far been recorded.

Psilostomum redactum is a small species of length 1·40 mm. The breadth is variable. Both anterior and posterior ends are somewhat bluntly pointed. The widest parts of the body occur at distances of about $\frac{2}{4}$ of the whole length from each end. The body narrows again in the middle. At the broadest parts the breadth is ·45 mm.; in the middle it is ·31 mm.; towards the end of the tail ·18 mm. The surface of the body is not armed with spines, but the cuticle has distinct longitudinal and transverse striations.

The oral sucker is subterminal and circular, with a diameter of ·16 mm. The ventral sucker is elliptical, with the long axis transverse; it measures ·38 × ·23 mm. The cuticle of the ventral sucker presents a beautifully distinct reticular striation.

The mouth opens in the oral sucker and is continuous with a large muscular pharynx, ·09 mm. broad. The gut branches into two diverticula immediately behind the pharynx. The diverticula widen as they pass down, so that they assume an almost sac-like shape, but towards the end they become

* Q. Jour. Micr. Sc., July 1865, p. 200, pl. viii.

constricted again. They very nearly reach the extreme tip of the tail.

The testes are large, irregularly-shaped bodies, situated one behind the other about $\cdot 45$ mm. from the posterior end of the body. Their long axis is transverse and is included between the gut-diverticula. The ovary lies just in front of the anterior testis, is smaller than the latter and of somewhat oval shape. The vitelline glands extend along each side of the body, ventral to the intestinal diverticula; they almost reach the ventral sucker anteriorly, and are only a short distance from the end of the tail posteriorly. The lobes are fairly large and are particularly voluminous in some parts.

The ova are not numerous (about 30), but are of considerable size, $\cdot 078$ to $\cdot 081$ mm. \times $\cdot 040$ to $\cdot 042$ mm. The genital aperture is in front of the ventral sucker, but somewhat to the left side of the middle line, a feature characteristic of the genus.

At the extreme tip of the tail is the excretory aperture, to which a long, narrow, straight tube runs down. At the top of this tube there was in the living specimen a distinct yellowish refractive body, oval in shape, measuring $\cdot 014 \times \cdot 012$ mm. After death this became less distinct and on keeping some time it almost entirely disappeared.

The only three species of this genus are all described by Mühlhing*. *P. redactum* agrees with them in their characteristic features, viz. (1) absence of œsophagus, (2) position of testes and ovary, (3) disposition of vitelline glands, (4) situation of genital aperture. It differs in habitat, however, for the others are described from the intestine of marine birds, *Harelda glacialis* and *Fuligula nyroca* (*Nyroca ferina*).

In another three-spined stickleback a specimen (Pl. XIII. fig. 10) differing in many respects from the foregoing was found. It presented the following features of difference:—

Length $2\cdot 54$ mm.; breadth, comparatively uniform, $\cdot 40$ – $\cdot 65$ mm. Pharynx proportionately small.

The testes are circular in outline and measure $\cdot 28$ mm. and $\cdot 35$ mm. in diameter respectively. The greatest difference occurs in the character and disposition of the vitelline glands, which in this specimen extend in front of the ventral sucker. The lobes also are smaller and much denser.

The ova are more numerous, but their size remains practically the same, viz. $\cdot 075$ to $\cdot 081$ mm. \times $\cdot 040$ to $\cdot 044$ mm. The

* Arch. f. Naturg. lxii. p. 243, and lxiv. p. 96.

genital aperture is well forward, on a level with the pharynx, but to the left of it.

This is probably an older example of *P. redactum*, and the differences are due to development.

EXPLANATION OF PLATES XII. & XIII.

The following letters apply to all the figures:—

<i>A.S.</i> Oral sucker.	}	<i>P.S.</i> Ventral sucker.
<i>Ph.</i> Pharynx (œsophageal bulb).		<i>G.A.</i> Genital aperture.
<i>V.S.</i> Vesicula seminalis.		<i>V.G.</i> Vitelline glands.
<i>Ov.</i> Ovary.		<i>T.</i> Testes.
<i>Ex.P.</i> Excretory pore.		<i>Sp.</i> Cephalic spines.
<i>O.</i> Ova.		<i>Dv.</i> Intestinal diverticula.
<i>S.G.</i> Shell-gland.		

- Fig.* 1. *Echinostomum secundum*. × 16.
Fig. 2. Ditto. Anterior end. × 60.
Fig. 3. Ditto. Lateral view of head.
Fig. 4. *Zeugorchis acanthus*. × 25.
Fig. 5. Ditto. Part of anterior end to show arrangement of spines (*c.s.*) on body. *G.P.* Genital papilla. × 60.
Fig. 6. Ditto. Posterior view of head. × 35.
Fig. 7. Ditto. Ovum. *E.S.* Eye-spots. × 100.
Fig. 8. *Levinsonia similis*. *G.S.* Genital sinus.
Fig. 9. *Psilostomum redactum*. *Ab.* Refractive body.
Fig. 10. Ditto. Older example.

LXIX.—*Descriptions and Records of Bees.*—XI.

By T. D. A. COCKERELL, University of Colorado.

AUSTRALIA (including Tasmania) possesses thirty-five described species of *Megachile*, all first described by F. Smith with the exception of three, made known by Fabricius, Radoszkowski, and Froggatt respectively. In 1904 I had an opportunity to study Smith's types in the British Museum, and I have now been permitted to work up the material which has accumulated in that Museum since Smith's time, the present paper being the result. I include in my tables two species of *Lithurgus*, which are easily confused with *Megachile*.

The Australian species of *Megachile* do not appear, for the most part, to be closely related to those of the Austro-Malay islands. Thus, of all the Australian species known in the female, only two have the ventral scopa black, and three or four have it red or fulvous, all the rest having it white or nearly so. The Austro-Malay islands are richly endowed with fifty-five described species, most of which have the scopa